(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 February 2002 (14.02.2002)

PCT

(10) International Publication Number
WO 02/12630 A1

(51) International Patent Classification[7]: E01C 7/14, 11/00, 11/16, 11/18, E04B 5/00, E04C 5/00, E02D 27/01, 27/02

(21) International Application Number: PCT/AU01/00950

(22) International Filing Date: 3 August 2001 (03.08.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
51830/00 4 August 2000 (04.08.2000) AU
PR 4999 15 May 2001 (15.05.2001) AU

(71) Applicant *(for all designated States except US)*: **BUILDING INNOVATIONS PTY LTD** [AU/AU]; 46 Iluka Avenue, Elanora Heights, NSW 2101 (AU).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **COLEFAX, Warwick, Ian** [AU/AU]; 46 Iluka Avenue, Elanora Heights, NSW 2101 (AU). **COLEFAX, Robert, Foster** [AU/AU]; Seven Springs Farm, Mason Road, Kuranda, QLD 4872 (AU). **GETALDIC, Miro** [AU/AU]; Australian Plastic Profiles Pty Ltd, 12 Cawarra Road, Caringbah, NSW 2229 (AU).

(74) Agent: **CULLEN & CO.**; Level 26, MLC Bldg, 239 George Street, Brisbane, QLD 4000 (AU).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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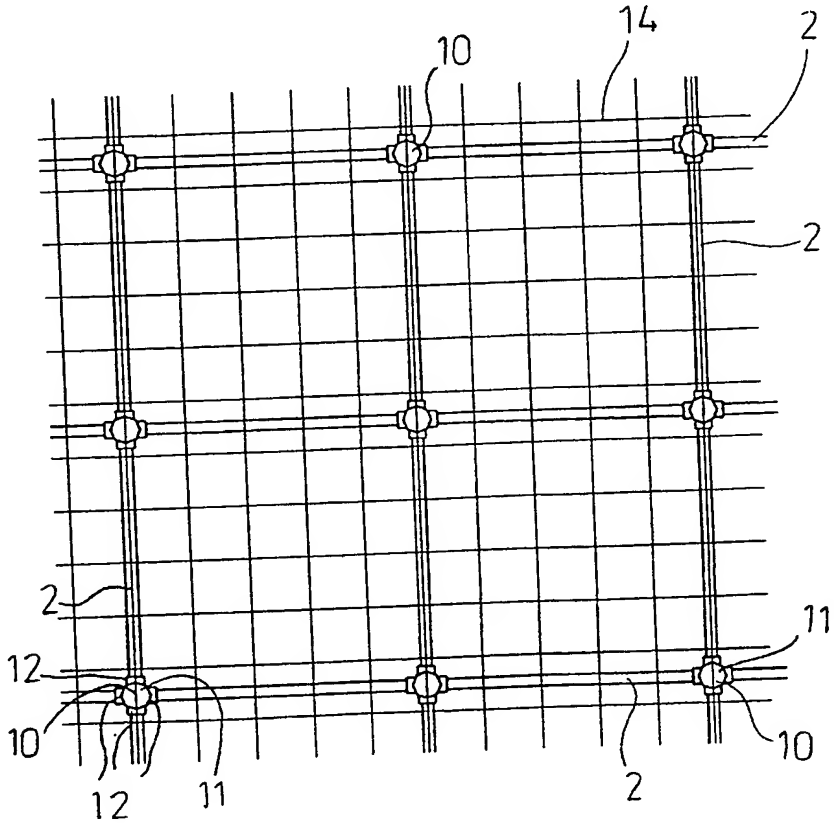
(54) Title: METHOD AND SYSTEM FOR CONSTRUCTING LARGE CONTINUOUS CONCRETE SLABS




(57) Abstract: A method and system is provided for constructing large continuous concrete slabs without using conventional shrinkage control joints. The system comprises a grid of closely spaced crack inducers (2) arranged relative to a concrete-pouring surface and adapted to be covered by concrete. The inducers (2) are connected to one another with connectors (10). The inducers (2) are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers (2) throughout the slab when the concrete sets.

WO 02/12630 A1

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**
— *with international search report*
— *with amended claims*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# METHOD AND SYSTEM FOR CONSTRUCTING LARGE CONTINUOUS CONCRETE SLABS

## FIELD OF THE INVENTION

This invention relates to a method and to a system for constructing large continuous concrete slabs using closely spaced, cast-in crack inducers.

## BACKGROUND OF THE INVENTION

Large concrete slabs such as commercial, retail and industrial floors, and continuous pavements such as concrete roadways and paths will crack during the hydration period due to drying shrinkage of the concrete and other effects if they are not detailed to accommodate the shrinkage strains. In the absence of shrinkage control joints, cracks will typically occur in concrete slabs and pavements in the first three months after placing, and these cracks will normally meander through the concrete at random locations.

Uncontrolled, visible cracks in concrete slabs and pavements are generally perceived by those observing them at best as ugly, and at worst, as failures. Furthermore, the uncontrolled cracks are weak regions which may fail under load, and uncontrolled cracks will widen and crumble under heavy traffic.

To remedy this problem in a conventional manner, shrinkage control joints of various types are introduced to provide a structural break in an attempt to accommodate and control the concrete shrinkage in predetermined locations. Although vastly superior to uncontrolled cracking, conventional control joints are expensive to install and they are often the first point of failure in floor slabs and pavements.

The control joints are vulnerable to damage in traffic areas, usually due to impact, and they become unsightly when the slab edges break away and when sealants fail. They can also be a hazard for pedestrians and some random cracks often still occur despite the installation of a pattern of control joints.

There are a number of different control joints that are typically specified by engineers in the construction industry to accommodate shrinkage cracking of concrete slabs and pavements. One of the most popular control

joints is a saw cut that is installed once the concrete has cured to the extent that it will support a worker. The depth of a suitable saw cut is typically twenty five percent of the total thickness of the slab and the spacing is typically three to six metres. Such a joint does not prevent cracking, but attempts to limit cracking to the saw cut locations and generally attempts to control cracking to straight lines. To achieve a relatively smooth finish and to seal the joint, saw cuts are usually filled with a suitable elastomeric material.

Unfortunately, this method is time consuming and involves a worker revisiting the slab after it has set to install the saw cut, and yet again to install the sealant. The additional time and material adds to the cost of preparing the concrete slab.

Other traditional and commonplace shrinkage control joints include formed dowel joints, keyed joints and tooled joints.

US Patent No. 6,092,960 relates to a concrete joint restraint system which secures dowel bars to a support structure. Use of dowel bars for transferring shear loads at joints in concrete pavement is known, and may provide a means to transfer forces across a joint. Using the invention of this patent, however, requires additional time and materials, and the use of joints.

US Patent No. 5,857,302 provides a means for controlling concrete slab cracking near walls or columns. The patent describes an outwardly extending vane perpendicular to the wall or column before pouring the concrete. The vane is orientated in line with a saw cut which is made after the concrete has set. Although this invention directs cracking in a straight line near walls or columns, additional time and labour are still required in making the saw cuts.

## OBJECT OF THE INVENTION

It is an object of the invention to provide a method and a system for constructing a large continuous concrete slab that overcomes or at least minimises a disadvantage referred to above.

## SUMMARY OF THE INVENTION

According to a first aspect of the invention, there is provided a method of constructing a large continuous concrete slab, said method comprising the steps of:

arranging a plurality of crack inducers relative to a concrete-pouring surface;

pouring concrete onto said surface to cover said inducers and to form the slab; and

allowing said concrete to set;

wherein said inducers are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers throughout the area of the slab.

According to a second aspect of the invention, there is provided a crack inducer system for inducing cracks in a large continuous concrete slab, said system comprising a plurality of crack inducers arranged relative to a concrete-pouring surface and adapted to be covered by concrete, wherein said inducers are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers throughout the area of the slab when said concrete sets.

## DETAILED DESCRIPTION OF THE INVENTION

The phrase "large continuous concrete slab" is used herein to denote a slab panel that has a surface area usually of at least about $500m^2$, wherein "large" means length alone or length and breadth, and wherein "continuous" means without control joints.

The phrase "concrete-pouring surface" is used herein to denote either an even surface or an uneven surface.

The instant method and system of slab construction teaches away from traditional approaches used to control contraction movements of a concrete slab. As opposed to increasing the size of unrestrained slab panels with control joints and increased reinforcement, the present invention teaches in effect decreasing the size of slab panels by introducing closely spaced crack inducers to induce fine cracking at regular and close centres. It has been discovered that closely spaced inducers distribute all shrinkage and thermal contraction cracking throughout the length and breadth of the slab. The cracks are induced at the moment the concrete begins to set. The fine cracks produced in the vicinity of the inducers are hardly visible and are generally of no structural consequence to the performance of the slab. As

to 3000mm centres. This spacing, however, may vary depending on the type of slab that is to be poured:- the thickness of the slab, whether slab reinforcing members are to be used (eg. fabric or bar reinforcement), and the surface finish. Crack inducers spaced at about 800mm to 1000mm centres can produce fine cracks and near to invisible cracks.

If the slab is to be subjected to significant fluctuations in temperature, the method can comprise a step of incorporating expansion joints.

Preferably, the method further comprises a step of stabilising the crack inducers to prevent excessive movement thereof.

The inducers can be stabilised by anchoring the inducers to the surface with fasteners (eg. stakes, pegs or the like if the slab is poured on grade/subgrade; staples, nails or the like if the slab is poured on formwork).

Alternatively, or additionally, the inducers can be stabilised by connecting at least some of the inducers to one another with connectors.

The connector can comprise a body and at least two arms extending from the body, wherein each arm is attachable to an end of a said crack inducer. The arms can be of any suitable shape and size. The arms can be attachable to crack inducers of slightly varying diameter. Preferably, each arm friction fits to an end of an inducer, but the arms can be attached in any other suitable way.

The arms can be of hollow construction. The connector can be, for instance, an electrical junction box or fitment. Junction boxes and the like are well known in the art.

Alternatively, each arm can comprise a plurality of fingers that extend from the body and which friction fit to an end of a crack inducer.

Alternatively, and preferably, each arm is provided by at least one blade that extends from the body and which friction fits within an end of a crack inducer. The blade or blades can be of any suitable shape, size and configuration.

Preferably, each arm comprises two blades that intersect at a midpoint such that an end of each arm is cross-shaped when viewed in transverse cross section. Such a configuration enables crack inducers with

slightly different diameters to be readily attached. The blades can also have ends that are tapered to facilitate attachment.

Preferably, the connector has four arms extending radially from the body.

The blades can also comprise flexible or flexibly resilient material so as to facilitate attachment.

The method can further comprise a step of holding at least one of the connectors in position on the surface before pouring the slab. The connector can simply be held in place with a slab reinforcing member (steel fabric and/or bar reinforcement) placed atop the connector.

Alternatively, or additionally, the connector can have securing means for being held against the surface. The securing means can be provided by the body having at least one aperture through which a nail, spike, peg or the like can extend.

The connectors can function as bar chairs. The connector can have a region for supporting steel fabric and/or bar reinforcement. The body can have at least one upstanding wall, a top region of which provides the support. Preferably, the connector has four upstanding walls. The top region of each wall can have a retainer extending therefrom for engaging a slab reinforcing member.

In a first preferred form of the invention, the connector comprises a cylindrical body with four arms extending from the body, wherein each arm comprises two blades that intersect at a midpoint such that an end of each arm is cross-shaped when viewed in transverse cross section. The connector can be fastened to the surface with a fastener extending through the cylindrical body. Such a connector can be used, for instance, with a fibre-reinforced slab.

In a second preferred form of the invention, the connector of the first preferred form can further comprise a ground-bearing base from which extends the cylindrical body, said base having a plurality of apertures through which fasteners (eg. nails, spikes and the like) can extend. The connector can further have a raised reinforcement lip extending about a periphery of the base. This lip can be continuous with some of the blades of the arms. Such

a connector can be used, for instance, with a fibre-reinforced slab.

In a third preferred form of the invention, the connector can comprise:

a body comprising:

a ground-bearing base having a plurality of apertures through which fasteners can extend to secure the connector to the surface;

four walls that extend upwardly from the base and which intersect at a central location of the body; and

a retainer that extends from a top of each said wall, wherein said retainer is adapted to engage a slab reinforcing member; and

arms in the form of blades that extend radially from an edge of each said wall and said base.

Preferably, the connectors comprise corrosion-resistant or non-corrosive material such as plastics material. The connectors can be produced by plastic injection moulding.

The term "comprise", or variations of the term such as "comprises" or "comprising", are used herein to denote the inclusion of a stated integer or stated integers but not to exclude any other integer or any other integers, unless in the context or usage an exclusive interpretation of the term is required.

## BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a detailed top plan view of a crack inducer system cast in a concrete slab, according to an embodiment of the invention;

Figure 2 is a cross sectional view of the crack inducer system and slab of Figure 1;

Figure 3 is a detailed perspective view of a crack inducer system according to an embodiment of the invention;

Figure 4 is a top plan view of a crack inducer system according to an embodiment of the invention;

Figure 5 is a cross sectional view of the crack inducer system of Figure 4 but cast in a concrete slab;

Figure 6 is a perspective view of a connector of a crack inducer system according to an embodiment of the invention;

Figure 7 is a perspective view of a connector of a crack inducer system according to an embodiment of the invention;

Figure 8 is a detailed top plan view of the connector of Figure 7 shown attached to some crack inducers of a crack inducer system;

Figure 9 is a perspective view of a connector of a crack inducer system according to an embodiment of the invention;

Figure 10 is a detailed top plan view of the connector of Figure 9 shown attached to some crack inducers of a crack inducer system; and

Figure 11 is a detailed side elevation view of the connector of Figure 10.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

In all of the figures, like reference numerals refer to like parts.

The figures show a crack inducer system for inducing cracks in a large continuous concrete slab 1. The system comprises a plurality of crack inducers 2 arranged relative to a concrete-pouring surface 3 and adapted to be cast in concrete. The inducers 2 are sized, shaped and spaced to promote fine cracking in the vicinity of the inducers 2 throughout the area of the slab when the concrete begins to set.

Figures 1-5 show that the crack inducers 2 are elongate. Figure 2 shows that the inducers 2 can be, for example, circular 4, hexagonal 5, rectangular 6 or triangular 7 when viewed in transverse cross section. Figure 2 further shows that a crack inducer 2 can comprise several elongate members 8 stacked or bundled together.

Figures 3-5 show a particularly preferred embodiment of the invention wherein the crack inducers 2 comprise PVC pipes. Inducers 2 of this form can be used to reticulate services, eg. electrical services.

Figure 2 and 3 show that the crack inducers 2 can be held in place on the surface with pegs 9 or the like (if grade or subgrade), or with nails or the like (if formwork).

Figure 1 shows that the crack inducers 2 can be arranged substantially parallel to one another. This may be desirable when constructing a continuous narrow pavement or path. Figures 3 and 4 show that for slabs of greater breadth (eg. driveways), the inducers 2 can be

arranged as a rectangular grid. The grid comprises a first group of spaced, substantially parallel inducers 2 and a second group of spaced, substantially parallel inducers 2 perpendicular to the first group.

The crack inducers 2 are preferably connected to one another with connectors. Various embodiments of connectors are shown in Figures 4-11. The connectors generally have a body and four arms extending therefrom. Figures 4 and 5 show a first embodiment of the connector 10, Figure 6 shows a second embodiment of the connector 20, Figures 7 and 8 show a third embodiment of the connector 30, and Figures 9-11 show a fourth embodiment of the connector 40. Connectors 20, 30 and 40 are preferably produced by plastic injection moulding.

Referring now to Figures 4 and 5, the connector 10 is an electrical junction box. The box 10 has a central generally cylindrical body 11 and four arms 12 extend from the body 11. Each of the arms 12 is hollow in construction and is attachable to an end of a crack inducer 2. The box 10 can serve as a bar chair, wherein steel mesh 14 rests on a top surface 13 of the box 10.

Referring now to Figure 6, the connector 20 comprises a cylindrical body 21 with four arms 22 extending from the body 21. Each arm 22 comprises two blades 22 that intersect at a midpoint such that an end of each arm 22 is cross-shaped when viewed in transverse cross section. Each arm 22 can friction fit to an internal surface of an end of an inducer 2 and can fit to inducers of slightly varying diameter as the inducers 2 can flex somewhat. The blades 22 are tapered at their ends 23 to further facilitate attachment.

The connector 20 can be held to the surface below by driving a peg, stake or the like through an aperture 24 of the cylindrical body 21. Connector 20 is of most use with fibre-reinforced slabs where steel mesh and bar reinforcement is not needed.

Referring now to Figures 7 and 8, connector 30 is similar to connector 20, except that it further has a ground-bearing base 31 from which extends the cylindrical body 21. The base 31 has a plurality of apertures 32 through which nails, spikes and the like may be driven into the surface below.

The base 31 also has a raised reinforcement lip 33 extending about a periphery of the base 31 and the lip 33 is continuous with some of the blades 22. Such a connector 30 is of most use when constructing a fibre-reinforced slab.

Referring now to Figures 9-11, the connector 40 has a body comprising a ground-bearing base 41, four walls 42 that extend upwardly from the base 41 and which intersect at a central location of the body, and a retainer 43 that extends from a top of each wall 42. The retainer 43 is adapted to engage a slab reinforcing member such as steel mesh, so that the steel mesh cannot slip off by accident.

The connector 40 also has four arms 47 each of which comprises two blades 47 that intersect at a midpoint such that an end of each arm 47 is cross-shaped when viewed in transverse cross section.

The base 41 has a raised reinforcement lip 45 extending about a periphery of the base 41. The base 41 also has a plurality of apertures 46 through which nails, spikes or the like may be driven into the ground to secure the connector 40 to the surface below.

Each wall 42 has a vertical end wall 48 that is situated above the lip 45. The end walls 42 taper towards the respective retainer 43. Each arm 47 extends from an end wall 48 and from the lip 45. The blades 47 have tapered ends 49 to facilitate attachment to the inducers 2.

In use, crack inducers are arranged on grade/subgrade or on a plastic membrane laid on grade/subgrade. The inducers may be arranged as shown in Figure 1 for narrow slabs (eg. pathways) or as shown in Figures 3-5 for wider slabs (eg. driveways, flooring). The inducers are spaced at 800mm-3000mm centres, preferably 800mm-1000mm centres. The ends of the inducers are connected with connectors. The inducers and/or connectors may be fastened to the surface below.

The connectors may double as bar chairs if steel fabric and/or bar reinforcement is to be used. If required, additional conventional bar chairs may be used. For suspended slabs, the inducers may be cast between top and bottom reinforcing members.

Once the inducers, connectors and reinforcing members are in

place, the concrete is poured and allowed to set. If the slab is likely to be subjected to major fluctuations in temperature, then conventional expansion joints may be used. Cold joint pour breaks, otherwise known as construction joints, can be used to break up the construction into manageable daily portions. As the concrete sets, a multitude of fine cracks propagate around the crack inducers, as opposed to large cracks propagating at distant and random centres.

The crack inducer system enables concrete slabs of virtually any size to be poured directly on grade without the need for control joints. The system components are quick and easy to install, and result in significantly cheaper construction and maintenance of slabs for retail, commercial and industrial purposes.

Conventional slabs on grade for retail, commercial and light industrial developments would generally contain formed or sawn control joints at 5-15 m centres in both directions. If the centres are increased, then there would usually also be an increase in the reinforcement.

The concept with conventional slabs on grade is that the control joints accommodate all of the shrinkage and thermal contraction strains, and that the reinforcement mesh limits crack width within each slab panel. It follows that the greater the spacing of the control joints, the larger the movement that has to be accommodated at each joint. The alternatives to date have been heavily reinforced continuous pavements and post-tensioned slabs. Both have been used to reduce the need for control joints when the cost increase can be justified, but neither is normally used for retail, commercial and light industrial floor slabs. Special detailing is required with these systems, and there is much room for error during construction. Also, problems often arise in accommodating the large movements that occur at the extremities of such slabs.

The inventors have moved in the opposite direction with the crack inducer system. Rather than increase the spacing of control joints and hence the potential movement that occurs at them, the inventors have replaced the joints with induced, regularly spaced fine cracks. Rather than increase the reinforcement for crack control of large slab panels, the inventors

have reduced it. Rather than providing for restraint-free shrinkage of large slab panels, the inventors have introduced restraint throughout the entire slab to assist crack induction at close centres.

The system revolves around the broad concept of inducing closely-spaced, hairline cracks above the crack inducers, so that the cracks will be of no consequence to the structural performance of the slab. The pattern of hairline cracks does not require surface treatment, does not adversely affect surface finishes if they are correctly applied, and is generally of no concern aesthetically. Further, there is minimal accumulation of stress in the bonding medium of any subsequently laid floor finishes, and no control joints to be reflected in the finishes.

Importantly, the cracks are induced from the moment the concrete begins to set. This, combined with the uniform spacing of the crack inducers and the uniformity of the slab and its reinforcement, provides the best possible opportunity for cracks to occur only where they are intended. With conventional sawn joints, for example, the initial wandering crack has often occurred before the saw cut is installed.

Also in contrast to conventional systems, where it is normal to implement measures to minimise restraint from the subgrade (eg. sand blinding layers), with the present system, special measures may be taken to increase subgrade friction and general shrinkage restraint, as they both help to ensure the cracks are induced at the regular centres.

The connectors can double as the reinforcement support. The reinforcing steel mesh is simply placed onto the connectors and the need for traditional bar chairs is generally eliminated. The connectors provide an extremely stable support for the reinforcing mesh, and in return the weight of the mesh is sufficient to hold the connectors and crack inducers in place during concrete placement.

A specific example of slab construction will now be described. The crack inducer system has been used to construct a 4,042 square metre floor area for a supermarket, without control joints. The slab was 125mm thick throughout and was reinforced with F62 mesh placed with about 30mm top cover. A grid of crack inducers was used to induce closely spaced fine cracks

throughout the area of the slab. The crack inducer grid comprised 33mm diameter PVC pipes at 1m centres in both directions, the diameter of the pipes being approximately 25% of the thickness of the slab. Four-way connectors were used to connect the crack inducers and to provide a surface at 70mm above the concrete-pouring surface to support the reinforcing mesh. The slab extended throughout the entire area of the supermarket, including the trading area, the cool rooms, the food preparation areas, and the reserves area.

Some of the advantages of the system for constructing slabs on grade can be summarised as follows:

- All formed and sawn control joints, together with sealants, are eliminated
- Reinforcement requirements may be reduced
- Skilled labour is not required to install the crack inducer/connector grid
- There are no formed or sawn control joints to have their edges broken or damaged during construction or during service
- The closely spaced pattern of fine cracks maximises the ability of a slab to accommodate minor ground movements without distress
- There is minimal and generally no risk of slab panels curling at the corners
- Large continuous areas of slab can be placed in a single concrete pour, the limitation generally being only the capacity of the contractor to place and finish the concrete
- Construction joints at pour breaks can be installed at short notice with minimum effort
- There are no control joints to be reflected in the applied finishes
- Conventional machinery can be used

There are significant reductions in construction time and cost produced by each of the above.

Whilst the above has been given by way of illustrative example of the invention, many modifications and variations may be made thereto by

persons skilled in the art without departing from the broad scope and ambit of the invention as herein set forth.

## CLAIMS

1. A method of constructing a large continuous concrete slab, said method comprising the steps of:

arranging a plurality of closely spaced crack inducers relative to a concrete-pouring surface;

pouring concrete onto said surface to cover said inducers and to form the slab; and

allowing said concrete to set;

wherein said inducers are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers throughout the area of the slab.

2. The method of claim 1, wherein said slab has a surface area of at least about 500$m^2$.

3. The method of claim 1, wherein said surface is a prepared ground surface.

4. The method of claim 1, wherein said fine cracks are generally less than about 0.5mm in width.

5. The method of claim 1, wherein said crack inducers are arranged substantially parallel to one another.

6. The method of claim 1, wherein said crack inducers are arranged as a grid.

7. The method of claim 1, wherein said crack inducers are arranged as a rectangular grid comprising a first group of spaced, substantially parallel inducers, and a second group of spaced, substantially parallel inducers perpendicular to the first group.

8. The method of claim 1, wherein said crack inducers are spaced at about 800mm to 3000mm centres.

9. The method of claim 1, wherein said crack inducers are spaced at about 800mm to 1000mm centres.

10. The method of claim 1, wherein said crack inducers are used to reticulate services.

11. The method of claim 1 further comprising a step of stabilising at least one crack inducer prior to pouring the concrete.

12. The method of claim 11, wherein said crack inducer is stabilised by anchoring said inducer to the surface with a fastener.

13. The method of claim 11, wherein said crack inducer is stabilised by connecting said inducer to at least one other inducer.

14. The method of claim 13, wherein said crack inducers are connected to one another with connectors.

15. The method of claim 14, wherein said connectors are attachable to crack inducers of slightly varying diameter.

16. The method of claim 14 further comprising a step of holding at least one of said connectors relative to the surface before pouring the slab.

17. The method of claim 16, wherein said connector is held in position with a slab reinforcing member placed atop the connector, wherein said connector functions as a bar chair.

18. The method of claim 16, wherein said connector has securing means for being held against the surface.

19. A crack inducer system for inducing cracks in a large continuous concrete slab, said system comprising a plurality of closely spaced crack inducers arranged relative to a concrete-pouring surface and adapted to be covered by concrete, wherein said crack inducers are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers throughout the area of the slab when said concrete sets.

20. The system of claim 19, wherein said crack inducers are elongate.

21. The system of claim 19, wherein said crack inducers are elongate and circular, rectangular or triangular when viewed in transverse cross section.

22. The system of claim 19, wherein at least one of said crack inducers comprises two or more elongate members stacked or bundled together.

23. The system of claim 19, wherein at least one of said crack inducers comprises a conduit.

24. The system of claim 23, wherein said conduit is a plastic pipe.

25. The system of claim 19, wherein said crack inducers are

arranged substantially parallel to one another.

26. The system of claim 19, wherein said crack inducers are arranged as a grid of any suitable pattern.

27. The system of claim 19, wherein said crack inducers are arranged as a rectangular grid comprising a first group of spaced, substantially parallel inducers, and a second group of spaced, substantially parallel inducers perpendicular to the first group.

28. The system of claim 19, wherein said crack inducers are spaced at about 800mm to 3000mm centres.

29. The system of claim 19, wherein said crack inducers are spaced at about 800mm to 1000mm centres.

30. The system of claim 19 further having connectors connecting at least some of said crack inducers to one another.

31. The system of claim 19, wherein at least one of said connectors comprises a body and at least two arms extending from the body, wherein each said arm is attachable to an end of a said crack inducer.

32. The system of claim 31, wherein each said arm is attachable to crack inducers of slightly varying diameter.

33. The system of claim 31, wherein each said arm is of hollow construction.

34. The system of claim 31, wherein each said arm is provided by at least one blade that extends from the body and which friction fits within an end of a said crack inducer.

35. The system of claim 34, wherein each said arm comprises two blades that intersect at a midpoint such that an end of each said arm is cross-shaped when viewed in transverse cross section.

36. The system of claim 35, wherein said blades have ends that are tapered to facilitate attachment to said crack inducers.

37. The system of claim 31, wherein said connector has four arms extending radially from the body.

38. The system of claim 31, wherein said connector is an electrical junction box or fitment.

39. The system of claim 31, wherein said connector has securing

means for being held against the surface.

40. The system of claim 39, wherein said securing means is provided by the body having at least one aperture through which a fastener can extend.

41. The system of claim 31, wherein the body of said connector has at least one upstanding wall, a top region of which provides support for a reinforcing member.

42. The system of claim 41, wherein said connector has four upstanding walls and the top region of each wall has a retainer extending therefrom for engaging a reinforcing member.

43. The system of claim 31, wherein said connector comprises a cylindrical body with four arms extending radially from the body, wherein each arm comprises two blades that intersect at a midpoint such that an end of each arm is cross-shaped when viewed in transverse cross section, and said connector can be secured to the surface with a fastener extending through the cylindrical body.

44. The system of claim 43, wherein said connector further comprises a ground-bearing base from which extends the cylindrical body, said base having a plurality of apertures through which fasteners can extend.

45. The system of claim 44, wherein said connector further has a raised reinforcement lip extending about a periphery of the base, and said lip is continuous with some of the blades of the arms.

46. The system of claim 31, wherein said connector comprises:

a body comprising:

a ground-bearing base having a plurality of apertures through which fasteners can extend to secure the connector to the surface;

four walls that extend upwardly from the base and which intersect at a central location of the body; and

a retainer that extends from a top of each said wall, wherein said retainer is adapted to engage a slab reinforcing member; and

arms in the form of blades that extend radially from an edge of

each said wall and from said base.

47. The method of claim 46, wherein said connector comprises corrosion-resistant or non-corrosive material.

48. The system of claim 31, wherein said connector is produced by plastic injection moulding.

AMENDED CLAIMS

[received by the International Bureau on 29 October 2001 (29.10.01)]

Claim 1 has been amended; claims 2 to 18 remain unchanged; new claims 19 and 20 have been added; claim 19 has been replaced by amended claim 21; claims 20 to 22 have been renumbered as claims 22 to 24; claim 23 has been replaced by amended claim 25; claims 24 to 45 have been renumbered as claims 26-47; claim 46 has been replaced by amended claim 48; and, claims 47 and 48 have been renumbered as claims 49 and 50.

1. A method of constructing a large continuous concrete slab having an area of at least about $100m^2$, said method comprising the steps of:

arranging a plurality of closely spaced crack inducers relative to a concrete-pouring surface;

pouring concrete onto said surface to completely cover said inducers and to form the slab; and

allowing said concrete to set;

wherein said inducers are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers throughout the area of the slab.

2. The method of claim 1, wherein said slab has a surface area of at least about $500m^2$.

3. The method of claim 1, wherein said surface is a prepared ground surface.

4. The method of claim 1, wherein said fine cracks are generally less than about 0.5mm in width.

5. The method of claim 1, wherein said crack inducers are arranged substantially parallel to one another.

6. The method of claim 1, wherein said crack inducers are arranged as a grid.

7. The method of claim 1, wherein said crack inducers are arranged as a rectangular grid comprising a first group of spaced, substantially parallel inducers, and a second group of spaced, substantially parallel inducers perpendicular to the first group.

8. The method of claim 1, wherein said crack inducers are spaced at about 800mm to 3000mm centres.

9. The method of claim 1, wherein said crack inducers are spaced at about 800mm to 1000mm centres.

10. The method of claim 1, wherein said crack inducers are used to reticulate services.

11. The method of claim 1 further comprising a step of stabilising at least one crack inducer prior to pouring the concrete.

12. The method of claim 11, wherein said crack inducer is stabilised by anchoring said inducer to the surface with a fastener.

13. The method of claim 11, wherein said crack inducer is stabilised by connecting said inducer to at least one other inducer.

14. The method of claim 13, wherein said crack inducers are connected to one another with connectors.

15. The method of claim 14, wherein said connectors are attachable to crack inducers of slightly varying diameter.

16. The method of claim 14 further comprising a step of holding at least one of said connectors relative to the surface before pouring the slab.

17. The method of claim 16, wherein said connector is held in position with a slab reinforcing member placed atop the connector, wherein said connector functions as a bar chair.

18. The method of claim 16, wherein said connector has securing means for being held against the surface.

19. The method of claim 1, wherein said crack inducers also function as slab reinforcing members.

20. The method of claim 19, wherein said crack inducers comprise bamboo or conduits.

21. A crack inducer system for inducing cracks in a continuous concrete slab having an area of at least about $100m^2$, said system comprising a plurality of closely spaced crack inducers arranged relative to a concrete-pouring surface and adapted to be completely covered by concrete, wherein said crack inducers are of a size, shape and spacing to promote fine cracking in the vicinity of the inducers throughout the area of the slab when said concrete sets.

22. The system of claim 21, wherein said crack inducers are elongate.

23. The system of claim 21, wherein said crack inducers are elongate and circular, rectangular or triangular when viewed in transverse cross section.

24. The system of claim 21, wherein at least one of said crack inducers comprises two or more elongate members stacked or bundled

together.

25. The system of claim 21, wherein at least one of said crack inducers comprises a conduit or a piece of bamboo.

26. The system of claim 25, wherein said conduit is a plastic pipe.

27. The system of claim 21, wherein said crack inducers are arranged substantially parallel to one another.

28. The system of claim 21, wherein said crack inducers are arranged as a grid of any suitable pattern.

29. The system of claim 21, wherein said crack inducers are arranged as a rectangular grid comprising a first group of spaced, substantially parallel inducers, and a second group of spaced, substantially parallel inducers perpendicular to the first group.

30. The system of claim 21, wherein said crack inducers are spaced at about 800mm to 3000mm centres.

31. The system of claim 21, wherein said crack inducers are spaced at about 800mm to 1000mm centres.

32. The system of claim 21, further having connectors connecting at least some of said crack inducers to one another.

33. The system of claim 21, wherein at least one of said connectors comprises a body and at least two arms extending from the body, wherein each said arm is attachable to an end of a said crack inducer.

34. The system of claim 33, wherein each said arm is attachable to crack inducers of slightly varying diameter.

35. The system of claim 33, wherein each said arm is of hollow construction.

36. The system of claim 33, wherein each said arm is provided by at least one blade that extends from the body and which friction fits within an end of a said crack inducer.

37. The system of claim 36, wherein each said arm comprises two blades that intersect at a midpoint such that an end of each said arm is cross-shaped when viewed in transverse cross section.

38. The system of claim 37, wherein said blades have ends that are tapered to facilitate attachment to said crack inducers.

39. The system of claim 33, wherein said connector has four arms extending radially from the body.

40. The system of claim 33, wherein said connector is an electrical junction box or fitment.

41. The system of claim 33, wherein said connector has securing means for being held against the surface.

42. The system of claim 41, wherein said securing means is provided by the body having at least one aperture through which a fastener can extend.

43. The system of claim 33, wherein the body of said connector has at least one upstanding wall, a top region of which provides support for a reinforcing member.

44. The system of claim 43, wherein said connector has four upstanding walls and the top region of each wall has a retainer extending therefrom for engaging a reinforcing member.

45. The system of claim 33, wherein said connector comprises a cylindrical body with four arms extending radially from the body, wherein each arm comprises two blades that intersect at a midpoint such that an end of each arm is cross-shaped when viewed in transverse cross section, and said connector can be secured to the surface with a fastener extending through the cylindrical body.

46. The system of claim 45, wherein said connector further comprises a ground-bearing base from which extends the cylindrical body, said base having a plurality of apertures through which fasteners can extend.

47. The system of claim 46, wherein said connector further has a raised reinforcement lip extending about a periphery of the base, and said lip is continuous with some of the blades of the arms.

48. The system of claim 33, wherein said connector comprises:

a body comprising:

a ground-bearing base having a plurality of apertures through which fasteners can extend to secure the connector to the surface;

four walls that extend upwardly from the base and which intersect at a central location of the body; and

a retainer that extends from a top of each said wall, wherein said retainer is adapted to retain a slab reinforcing member; and

arms in the form of blades that extend radially from an edge of each said wall and from said base.

49. The method of claim 48, wherein said connector comprises corrosion-resistant or non-corrosive material.

50. The system of claim 33, wherein said connector is produced by plastic injection moulding.

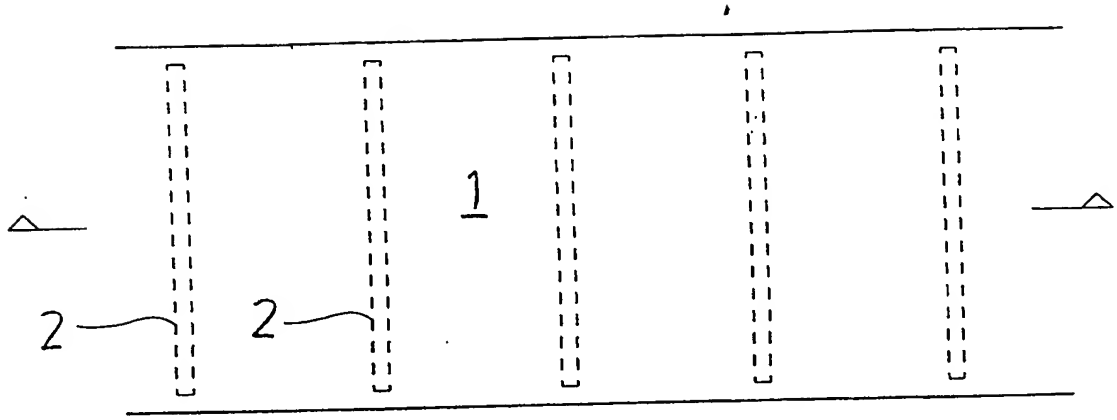



FIG. 1

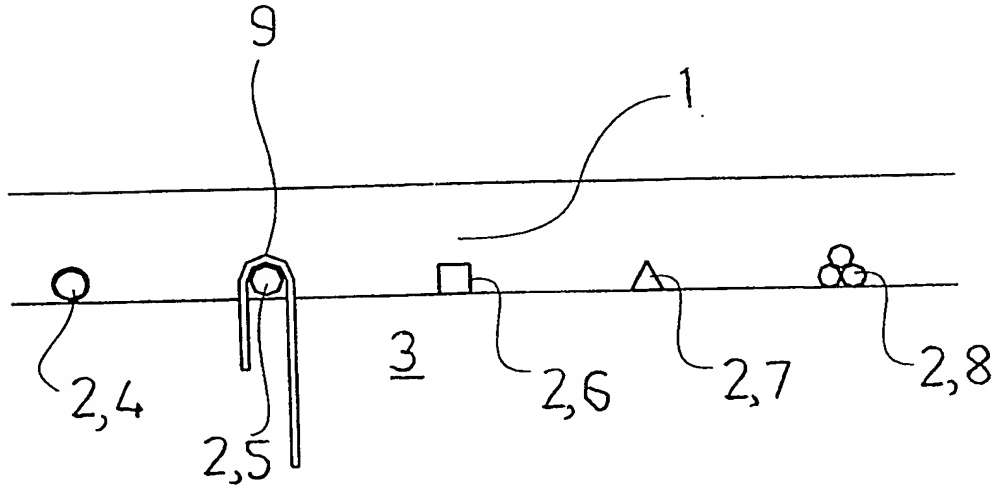



FIG. 2

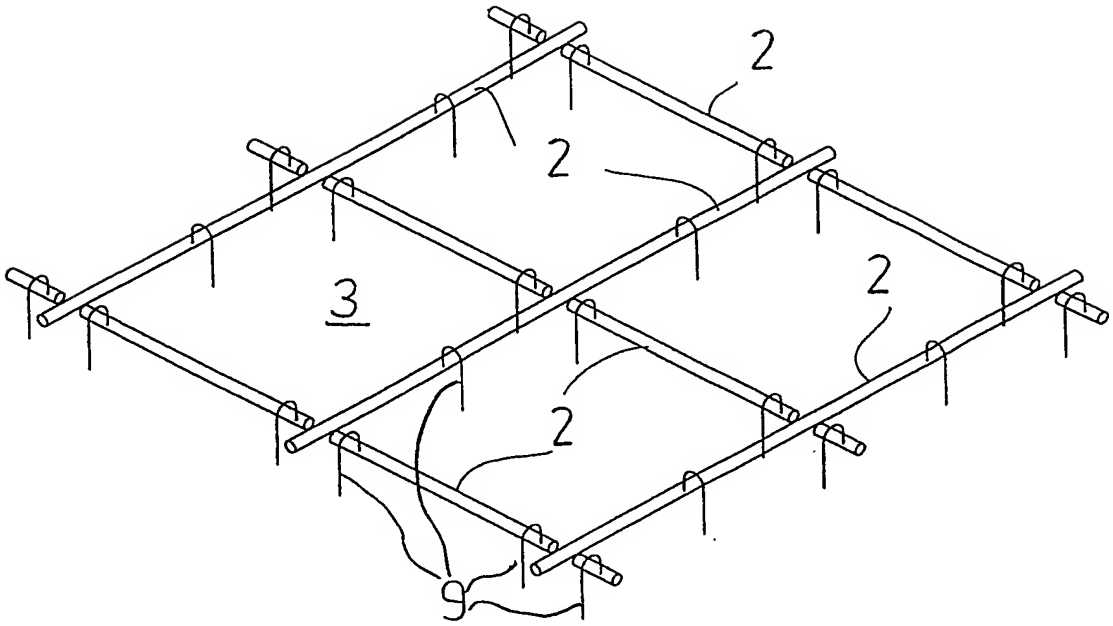



FIG. 3

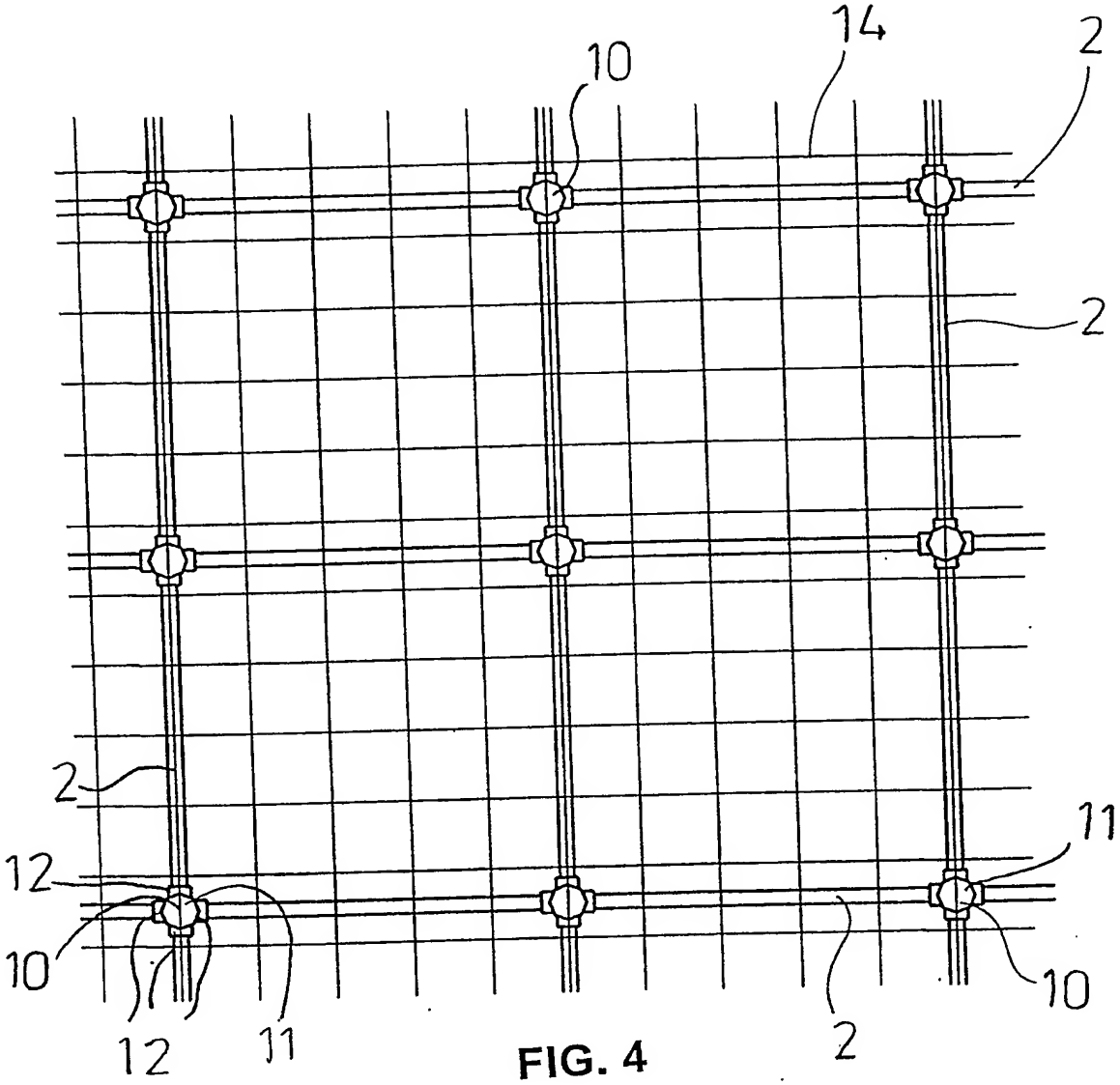



FIG. 4

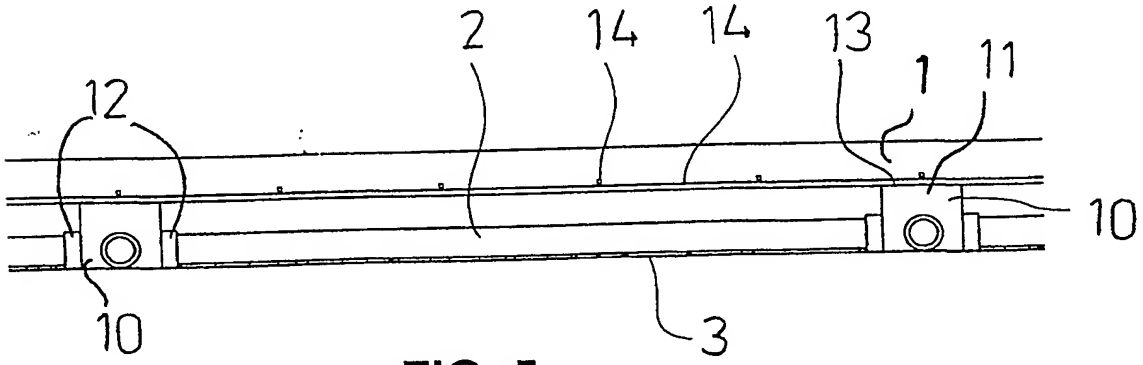



FIG. 5

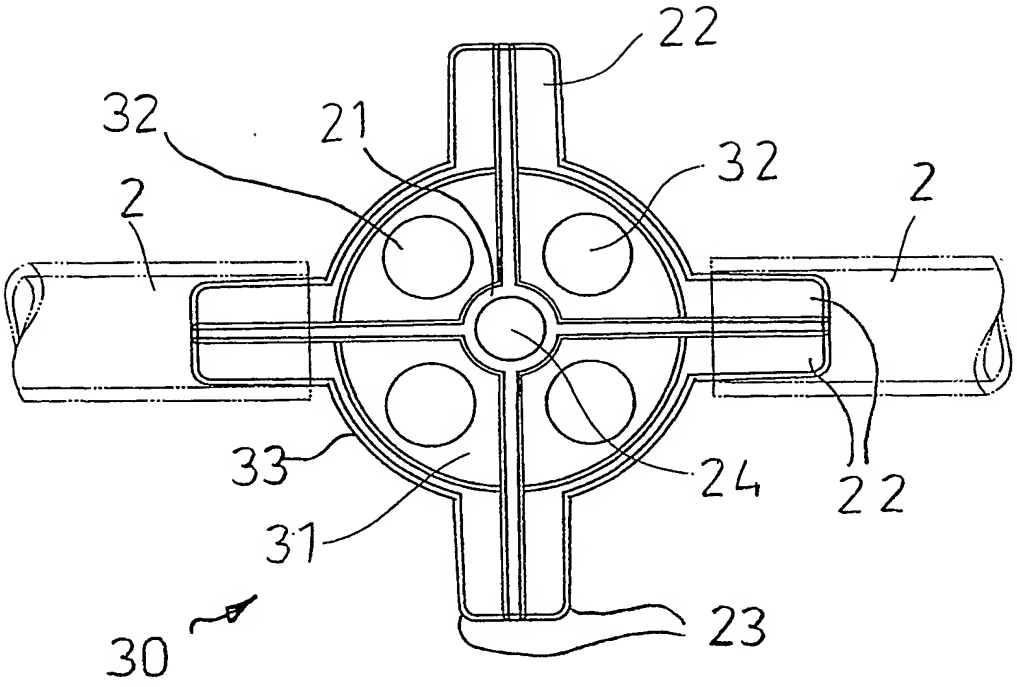



FIG. 8

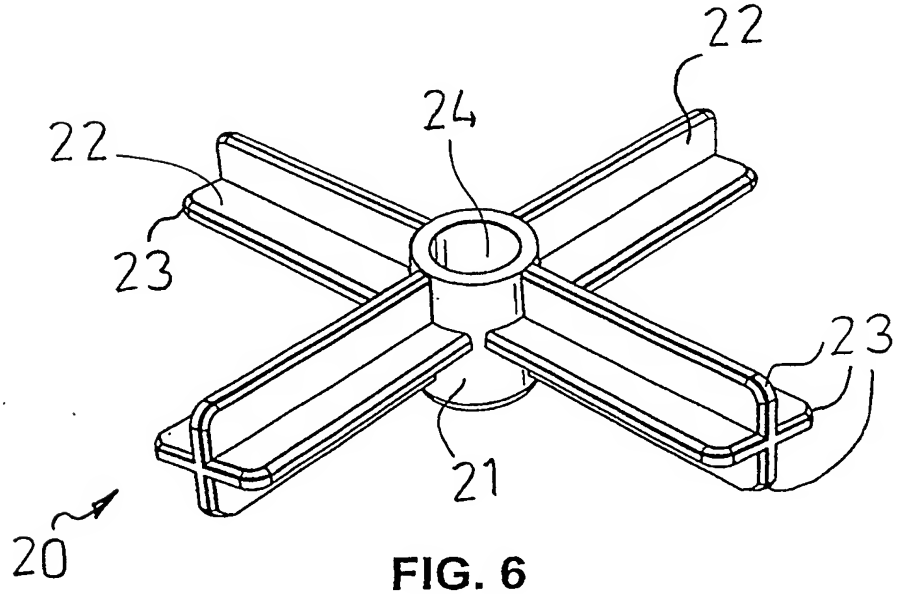



FIG. 6

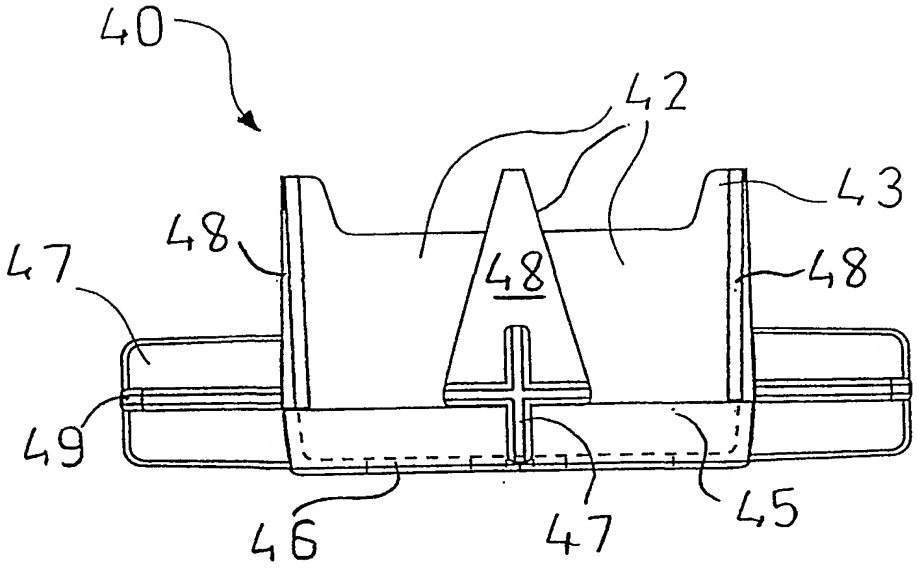



FIG. 11

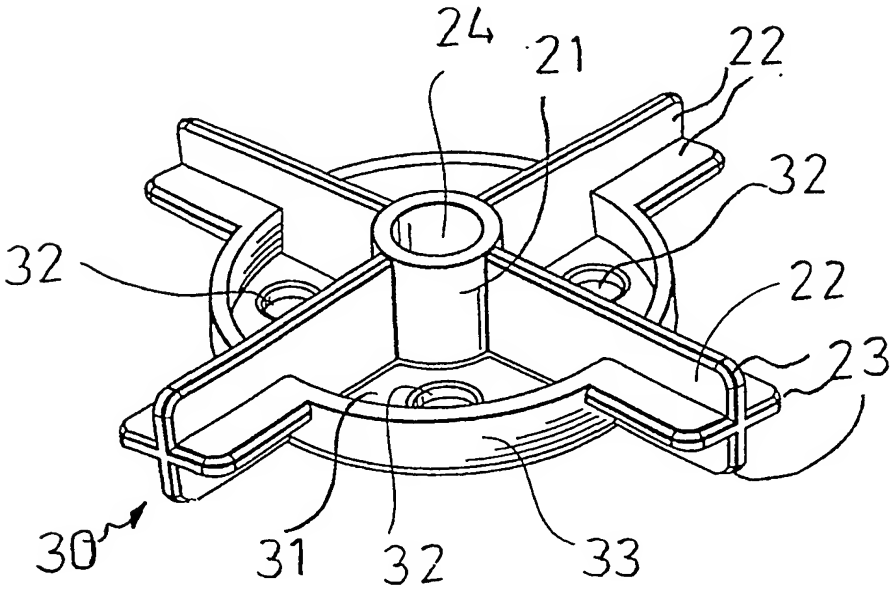



FIG. 7

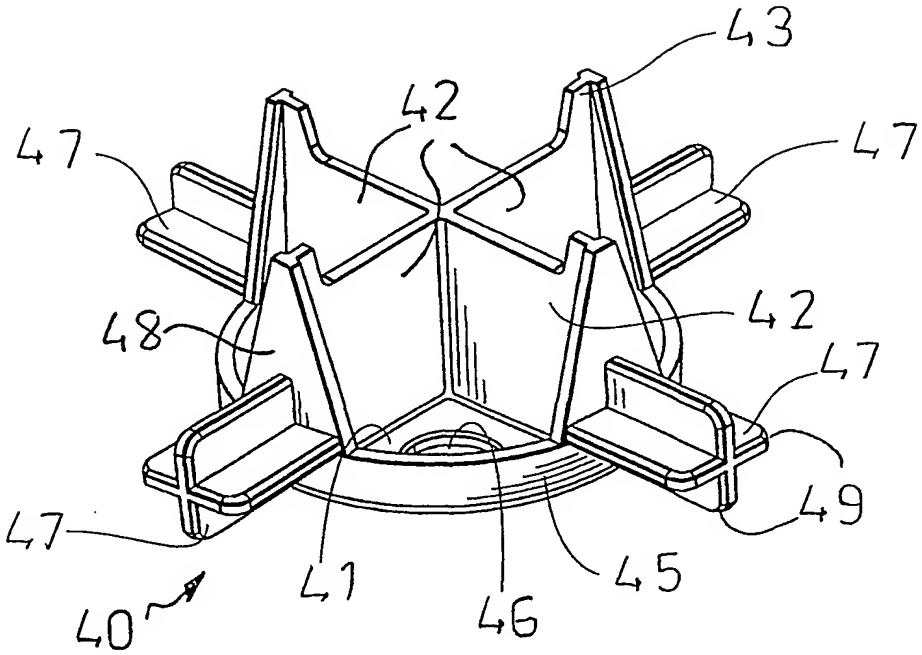



FIG. 9

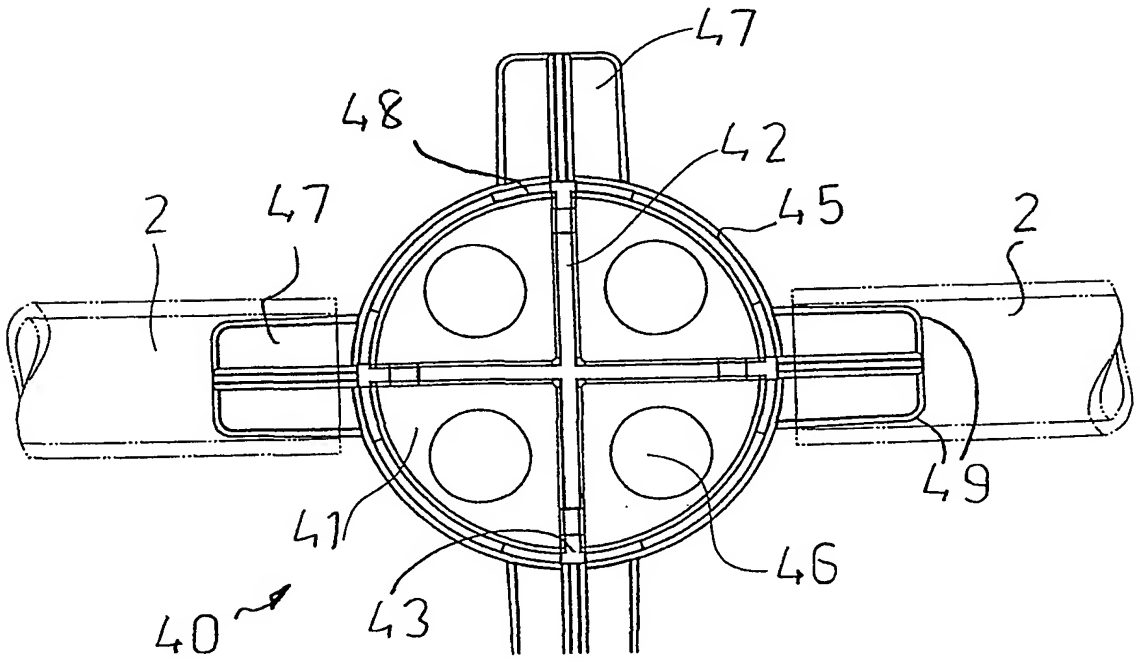



FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU01/00950

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl. [7]: E01C 7/14, 11/00, 11/16, 11/18, E04B 5/00, E04C 5/00, E02D 27/01, 27/02

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC (7) : E01C 7/14, 11/00, 11/16, 11/18, E04B 5/00, E04C 5/00, E02D 27/01, 27/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | AU 52686/98 A (UNDERWOOD) 30 July 1998 | 1-9, 11-22, 25-30 |
| X | GB 1570396 A (W R GRACE Ltd) 2 July 1980 | 1,19 |
| X | AU 44382/93 A (STEEL PRODUCTS Ltd) 10 February 1994 | 1-9, 11-22, 25-30 |
| X | DE 2825979 A (LESCHUS) 20 December 1979 | 1, 19 |
| X | US 5918428 A (HOUGH) 6 July 1999 | 1, 19 |
| X | GB 2045310 A (BURMAH INDUSTRIAL PRODUCTS) 29 October 1980 | 1, 19 |

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
27 August 2001

Date of mailing of the international search report
31 AUGUST 2001

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
E-mail address: pct@ipaustralia.gov.au
Facsimile No. (02) 6285 3929

Authorized officer

DAVID LEE

Telephone No : (02) 6283 2107

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU01/00950

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in Search Report | | Patent Family Member |
|---|---|---|
| AU | 52686/98 | NONE |
| GB | 1570396 | NONE |
| AU | 44382/93 | NZ 243822 |
| DE | 2825979 | NONE |
| US | 5918428 | NONE |
| GB | 2045310 | NONE |

END OF ANNEX